

# X-CIRCULAR POLARIZE MICROSTRIP PATCH ANTENNA

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This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours

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PROJEK SARJANA MUDA II

Tajuk Projek : X-CIRCULAR POLARIZE MICROSTRIP PATCH  
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## **DEDICATION**

Thanks for all lecturer at FKEKK Utem that help me to complete this thesis and also to my mother PN. Haslindah Md Hashim and my father Ahmad Mufit Marzuki and to my sibling for helping me. To Mr Zoinol and Mr Shukor thank you for your ideas that give to me to complete the thesis.

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## ABSTRACT

In this thesis, a project of x-circular polarize microstrip patch antenna with resonant frequency at 2.4GHz with higher gain and directivity and circular polarization in x-form for ISM band application is presented. A design of X-Circular Polarize Microstrip Patch Antenna from type of circular slot patch antenna oriented at  $45^{\circ}$  and  $-45^{\circ}$ . The antenna is capable to generate circular polarization in X form. Besides that, a design of x-circular polarize microstrip patch antenna to avoid loss caused by multipath effects which is antenna required circular polarization. Design x-circular polarize microstrip patch antenna to avoid mispolarization happen from misalignment of transmitter and receiver antenna. First step is design and simulate x-circular polarize microstrip patch antenna using CST Microwave Studio software to obtain the return loss, bandwidth, radiation pattern, gain, directivity and surface current. In order to verify the results, the antenna is fabricated by using chemical etching process. After that, the return loss is measured by using *Advantest Network Analyzer* while gain and radiation pattern is measured by using *ME 1300 antenna training kit* and x-circular polarize microstrip patch antenna as a receiver and horn antenna as a transmitter antenna. The result obtain showed the return loss of the antenna is lower than  $-10\text{dB}$  at 2.4 GHz and produce higher gain and directivity. Furthermore, the polarization of antenna is x-circular polarization at  $\pm 45^{\circ}$  which also has acceptable gain.

## ABSTRAK

Dalam thesis ini menceritakan tentang projek *X-circular polarize microstrip patch* antenna dengan frekuensi 2.4GHz dan mempunyai gandaan dan keterarahan yang tinggi dan mempunyai *x-circular polarization* untuk di aplikasikan pada ISM band aplikasi. Antena ini berasal dari jenis *circular slot patch* antenna yang di sengetkan pada sudut  $+45^0$  dan  $-45^0$  dan antenna mempunyai kebolehan untuk menjana polariti bulatan dalam bentuk x. Selain itu, antenna ini boleh mengelakkan kehilangan signal disebabkan efek *multipath* dimana antenna memerlukan polariti bulatan untuk mengelakan kehilangan signal dari berlaku. Antara sebab rekaan antenna ini adalah untuk mengelakan *mispolarization* dari berlaku yang disebabkan daripada ketidaksamaan atau tidak sejajar antara antenna penghantar dan penerima. Antena di design dan disimulasi menggunakan CST software untuk melihat kehilangan pembalikan, lebar jalur, polar sinaran, gandaan, keterarahan dan arus pada permukaan. Antena di fabrikasi menggunakan bahan untuk *etching* proses. Selepas itu, antena di ukur kehilangan pembalikan menggunakan *Advantest Network Analyzer* manakala gandaan, keterarahan dan polar sinaran di ukur menggunakan *ME 1300 antenna training kit* di mana antena yang direka sebagai menerima dan horn antena digunakan sebagai antena penghantar. Keputusan yang diberikan dimana kehilangan pembalikan bawah dari -10db pada frekuensi 2.4GHz dan mempunyai gandaan dan keterarahan yang besar.



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## LIST OF ABBREVIATIONS

CST – Computer Simulation Technology

IEEE – Institute of Electrical and Electronics Engineers

E – Electric Field Vector

H – Magnetic Field Vector

P – Poynting Vector

$P_{Ref}$  – Receiving power of a reference antenna

$P_{Test}$  – Receiving power of a test antenna

S – Scattering

RL – Return Loss

BW – Bandwidth

FNBW – First Null Beamwidth

HPBW – Half Power Beamwidth

$\epsilon_r$  – Dielectric constant

$f_r$  – Resonant Frequency

$\tan \delta$  – Tangent Loss

$h$  – Height of substrate

$W$  – Width

$L$  – Length

$\epsilon_{\text{eff}}$  – Effective dielectric constant

$\Delta L$  – Extended incremental length

$L_e$  – Effective length

$R_{\text{in}}$  – Resonant input resistance

$y_o$  – Inset feed-point distance

$Z_o$  – Input impedance

FR-4 – Flame Resistant 4

ISM – Industrial Scientific and Medicine

$L_f$  – Length of feedline

$W_f$  – Width of feedline

AUT – Antenna Under Test

Tx – Transmitter

Rx – Receiver

$\ell/2$  – Length of feedline connected with the rectangular patch

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## CHAPTER I

### PROJECT BACKGROUND

The project background consist of introduction, objective, scope of work, problem statement and project methodology.

#### 1.1 Introduction

The ISM radio band were for the use of radio frequency (RF) energy for industrial, scientific and medical purposes. The application in these bands such as Bluetooth and WLAN (wireless LAN) at 2.4GHz. The development of wireless communication system has been rapidly growth in this era with increasing demand in the level of enhancement and performance. A good antenna has high gain, small physical size, broad bandwidth and versatility. A microstrip patch antenna is one of the antennas that have the advantages such as light weight, small size, and low in cost, conformability and possibility of integration with active devices. The microstrip